PRELIMINARY OUTLINE OF A NEW CLASSIFICATION OF THE HELICES.

BY HENRY A. PILSBRY.

For several years the writer has been accumulating data bearing upon the natural classification of the Helicoid land snails. It has been thought desirable to place before students of this group some of the general results attained, and to invite their friendly criticism.

It will be understood that the consideration of many important points, such as the relations of Helices to certain Bulimoid groups, must be omitted from so brief and synoptical a paper as this; the author's aim being simply to place before malacologists the outlines of a classification essentially modern and essentially original. It can scarcely be expected that an arrangement in which most of the traditions of our Fathers in Conchology have been disregarded, will prove acceptable to all, or, indeed, in all respects worthy of acceptance; but it is hoped that it will be found an improvement on previous systems.

The anatomical details of numerous groups herein for the first time described will be figured in the author's more elaborate work now in preparation, to be issued in 1893.[1]

The notes given below under each genus must not be taken for complete generic diagnoses. I hold that for the establishment of genera the characters of the shell must be taken into account, as well as those of the genital system and of the jaw and lingual ribbon. For the formation of groups higher than genera, certain modifications of the genitalia seem to be most constant and availa-

[1]The principal authorities consulted are the following:

Binney, W. G., Terr. Moll. U. S. vol. V, etc.

Pfeffer, Georg, Beitr. zur Kenntniss Mex. l. u. fr.–w. Conch., etc.

Fischer, Paul, Numerous papers in the Jour. de Conch. and Moll. Mex. et Guat.

Hedley, Chas., Proc. Roy. Soc. Queensl. and Proc. Linn. Soc. N. S. W.

Hutton, F. W., Trans. N. Z. Institute.

v. Ihering, H., Morphol. u. Syst. des Genit. von Helix. This paper, the *erster Thiel* of which is before me, is a very valuable one and indispensable to the student of Pulmonate morphology.

Lehmann, Die Lebenden Schn. Stettins.

Pilsbry, H. A., Proc. Acad. Nat. Sci. Phila., 1888–1892.

Schmidt, A., Des Geschlechtsap. der Stylom.

Schako, G., Numerous papers.

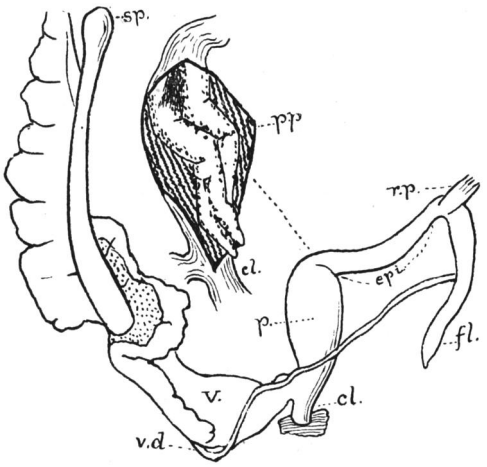
Semper, C., Reisen im Archip. Phil. Landmoll.

Suter, H., Trans. N. Z. Institute.

Tapparone Canefri, C., Annali Mus. Civ. Genova.

ble. Before proceeding with the descriptions of genera it may be well to describe briefly the organs to be discussed.

In the accompanying figure, representing the genitalia of *Helix*



Camænella platyodon Pfr.

platyodon Pfr., a species of the island of Hainan, the male system is seen branching toward the right, the female system toward the left. The systems unite below, forming the *vestibule* or *atrium*, sometimes called genital cloaca (*cl.*); and they are also united above; the hermaphrodite gland or *ovotestis*, giving off both spermatozoa and immature ova which travel through the much convoluted hermaphrodite duct or ovisperm duct, to the base of the albumen gland, where the duct separates into oviduct and vas-deferens.

The *penis* (*p*) is in its simplest form a muscular sack receiving the *vas-deferens* (*v. d.*) and the retractor muscle (*r. p.*) at its summit. There are often developed upon the penis one or more of the following accessory organs: (1) the *appendix*,[2] a glandular or flagellum-like organ inserted at the middle or near the base of the penis sack (see this volume, plate 13, fig. *F*, at *x*, *x.*); (2) the *penis-papilla* (see *p. p.* of the annexed figure) seen only by splitting the muscular penis wall. This papilla is perforated near its base for the exit of the spermatophores; (3) the *epiphallus*[3] (*epi.*), a

[2]See v. Ihering, Morphol. u. Syst. Helix, i, p. 396.

[3]In the epiphallus the spermatozoa are gathered into variously covered masses, or spermatophores. Simroth calls the corresponding organ in the slugs the "*Patronenstrecke*."

slender continuation of the penis backward, extending to the insertion of the vas-deferens, and usually continuing beyond this insertion as a flagellum. The retractor is sometimes situated upon the epiphallus instead of at the apex of the penis itself, this arrangement being shown in the figure here given. (4) The *flagellum* (*fl.*) a whip-lash shaped organ inserted upon either the summit of the penis or upon the epiphallus. The female system consists of the *vagina* (*v.*), which bifurcates to form the spermatheca or *receptaculum seminis* (*sp.*), and the *uterus*, a sacculated organ often containing eggs or young in various states of development. Surmounting the uterus is the albumen secreting gland, at the base of which the hermaphrodite duct enters the oviduct and vas-deferens. Besides the organs above described, the female system in some groups possesses a *dart sack* or sacks secreting a dart, and one or two *mucous glands*, these organs being inserted upon the vagina. Another organ of rare occurrence is the *appendicula*, an elongated simple diverticulum also emptying into the vagina. This diverticulum is supposed by v. Ihering to be homologous with the *appendix* of the male system; and it is certainly strong evidence of the correctness of his view that no form yet known possesses both appendix and appendicula. It is further held by him that the dart sack in *Zonitidæ* is the homologue of the appendix; but this theory requires before adoption much stronger evidence than has been given.

From the foregoing it will be seen that the following points should be carefully observed when dissecting the genitalia of Helices: Shape of the penis and presence or absence of internal papilla and external appendix; presence or absence of flagellum or epiphallus; point of insertion of the retractor muscle and of the vas deferens. Upon the female system should be noticed the absence or presence and form of dart sacks, darts, mucous glands or appendicula; the length of the spermatheca duct; the form of the cœca of the ovotestis and whether they are imbedded in the liver or free; and finally whether the right eye-peduncle is retracted between the branches of the genitalia or to the left side.

The flagellum, the dart sack and accompanying mucous glands, and the diverticulum upon the spermatheca duct may be regarded as structures developed since the differentiation of the Helices from other stocks; but the appendix and probably the appendicula, when present, have been inherited from that primordial stock from which the Helicidæ, Pupidæ, Bulimi etc. have diverged. As is sometimes

the case with ancient characters, we find these features retained in a number of very dissimilar genera.

The characters and value of the jaw as a basis for classification have been much misunderstood in the past, and even yet there are a number of unsettled questions concerning it. On some points, however, we may speak with considerable confidence. One such is the fact that *the strongly ribbed type of jaw* (odontognath) *intergrades by imperceptible stages with the entirely smooth, Zonites-like type* (oxygnath). Examples illustrative of this dictum are numerous, the restricted section *Caracolus* of Eastern Cuba and Haiti and the section *Dentellaria* being unquestionable instances of intergradation, some species of each of these groups being typically oxygnathous, others being pronouncedly odontognathous. To W. G. Binney is due the credit of first pointing out the fact and insisting upon its implications. The writer has confirmed it by the examination of numerous additional species. It is hardly needful to say that in many groups of Helices, odontognathy and oxygnathy are therefore controvertible terms, as far as classification is concerned, and consequently cannot be used for the separation of genera or even subgenera, unless supported by other and more stable characters.[4]

The jaw composed of a number of separate and similar squarish plates, more or less overlapping at the outer edges (such as that of *Punctum*), is comparable to an *unsoldered* jaw of the plaited (or stegognath) type.

Primarily the Helicoids are divisible into a number of groups, as follows:

Eggs or young very large at birth (¼ to ⅓ the diameter of the adult shell) *Group I,* MACROON.

Eggs or young smaller or minute at birth.

a. ♀ genital system having a dart sack and mucous gland. *Group II,* BELOGONA.[5]

aa. ♀ system lacking accessories; ♂ system with flagellum and appendix on penis; no epiphallus. *Group III,* TELEOPHALLA.

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[4]In some species of *Dentellaria* the sculpture of the jaw is not even constant as a specific character.

[5]The terms "Haplogon" and "Belogon" were proposed by v. Ihering, Morphol. u. Syst. Genitalapparates Helix, i, p. 401, 402.

aaa. ♀ system lacking accessories; ♂ system having epiphallus on penis; no appendix.

Group IV, EPIPHALLOPHORA.

aaaa. ♀ and ♂ genital systems lacking all accessory organs.

b. Jaw soldered into one piece.

Group V, HAPLOGONA.[5]

bb. Jaw composed of 16–24 separate plates.

Group VI, POLYPLACOGNATHA.

Group I, MACROON Pilsbry.

Manual of Conchology (2), VI, p. 57, 1890.

Arboreal or ground living Helicoids, reproducing by eggs of relatively very large size (one-fourth to over one-third the diameter of the adult shell) and few in number; sometimes viviparous. The embryonic shell is correspondingly large, and sculptured differently from the subsequent growth. Some genera now classed with the Bulimi may prove to belong here, besides the following:

Genus ACAVUS Montfort.

Oviparous; genital organs lacking all accessory appendages; duct of the spermatheca short. Jaw smooth. Teeth all simply unicuspid.

Subgenus PYROCHILUS Pilsbry.[7]

This group will probably prove to be a section or subgenus of the Ceylonese genus, as Dr. v. Moellendorff has pointed out. It is still unknown anatomically.

Genus STYLODONTA C. & J.

Viviparous; ♀ genital system lacking accessory appendages, but ♂ system having a flagellum upon the penis; duct of the spermatheca long. Jaw not ribbed. Median teeth unicuspid, but marginals bluntly trifid.

Distribution: Seychelles Islands.

Genus HELICOPHANTA Fer.

Group II, BELOGONA.

Female genitalia provided with one or two dart-sacks and mucous glands.

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[7]This name is proposed to supersede *Phania* Albers, 1860, that term being preoccupied for an apparently valid genus of Diptera described by Meigen in 1824. Type, *Helix pyrostoma*.

Jaw coarsely ribbed (odontognath), finely ribbed (pycnognath), or smooth (oxygnath).

The appendages of the ♀ system mentioned above are developed in no other group of Helices.[8]

Genus HELIX Linne (restricted).

Pilsbry, Proc. A. N. S. Phila., 1891, p. 313.

Genitalia: ♀ system having a dart-sack or sacks containing darts, a pair of mucous glands or one, the spermatheca duct long and provided with a long diverticulum; ♂ system having a flagellum upon the penis, and rarely an appendix.

Jaw stout, strongly ribbed. Teeth of the radula normal.

Shell various; animal reproducing by many small eggs.

Only in the more highly organized species are all the above characters of the genitalia developed. In many sections of the genus several of the accessory organs may be absent. I am disposed to think that in some cases the genital system has arrived at a simple condition by degeneration or loss of the accessory organs. It is upon this ground that I admit *Cressa* West. (*Pseudocampylæa* Hesse, non Pfr.) to the genus.

The genus is more numerous in species than any other; and a large number of subgeneric and sectional groups have been instituted for their classification. The anatomy of a great number of species has been investigated, and a sufficient basis of facts is known to enable us to divide the genus into several well-marked subgenera, all of which are represented in the Palæarctic Region, which has been, no doubt, the birth-place of this type. As it is not my purpose to enter into the question of the subdivision of this genus here, I will simply enumerate the leading groups in the several geographical regions, viz.: (1) Eur-African, (2) East-Asiatic, and (3) American.

The EUR-AFRICAN area comprises the greatest variety of types, both recent and fossil, and the genus doubtless originated and developed its peculiarities therein. The more prominent subgenera or sections are as follows: *Arianta, Campylæa, Elona, Chilotrema, Isognomostoma,*[9] *Pomatia, Eremina, Macularia, Tachea, Iberus, Hemicycla, Leptaxis, Plebecula, Eulota, Fruticicola, Euparypha, Xerophila,* including many sections and a vast number of species,

[8] v. Ihering holds, I believe correctly, that the so-called darts of Zonitidæ are not homologous with those of these Helices.

[9] See Pilsbry, Journ. de Conchyl., 1891, p. 22.

and finally the peculiar forms of the Atlantic Islands: *Ochthephila, Tectula, Craspedaria*, etc., etc.

Here, too, belong the tertiary Helices which authors have always referred to *Coryda, Geotrochus*, etc., such as *H. rugulosa, crepidostoma, bohemica, hortulana*, etc., etc. The sadly mis-named subgenera *Dentellocaracolus* and *Prothelidomus* of Oppenheim also fall into the restricted genus *Helix*, near *Macularia* and *Leptaxis, Hemicycla*, etc. Boettger has criticised Oppenheim on the *conchology* of his "Paläontologisch–Zoogeographische Studie," but his zoo-geographical conclusions and implications are even more erroneous. It is time that we heard the last of this habit of going to the ends of the earth to find subgenera for the European fossil Helices! With the exception of a few divergent branches which apparently have left no descendants, all of the European tertiary Helices belong to subgenera still occupying some part of the Palæarctic realm, or at farthest the Holarctic area. The supposed *Corasia, Chlorœa, Eurycratera, Coryda, Dentellaria, Obba, Chloritis, Thelidomus, Mesodon, Triodopsis*, etc., which have been reported from the Eocene, Oligocene and Miocene of Europe, belong in no case to those groups, but, for the greater part to the genus *Helix* as above restricted. Many of them can readily be referred to recent subgenera and sections, such as *Campylœa, Gonostoma*, and especially to that primitive stock called "Pentatænia" by Schmidt and Sandberger, from which sprung the *Tachea, Macularia*, etc., of the recent fauna.

The EAST ASIAN area of distribution is in reality connected with the Eur-African, by way of Siberia, but as the species of the intermediate region are few on account of its at present unfavorable climatic conditions, the connection is not effective in preventing divergence of types. We therefore find that the East Asian forms belong mainly to distinct subgenera or sections. The European *Eulota*, however, is very closely allied to *Dorcasia* (+ *Acusta*) of Asia; and the Chinese section *Metodontia* Mlldff. is scarcely separable from *Petasia* (*H. bidens*, etc.) of Europe. We also find closely allied species of *Vallonia, Carocolina*, etc., inhabiting China and Europe. Besides the above mentioned groups, the following are to be referred here as sections of *Helix: Plectotropis* Alb., *Aegista* Alb.,[10] *Cathaica* Moell., *Satsuma* Ads., *Euhadra* Pils. (type *H. peliomphala* Pfr.).

[10]See Proc. A. N. S. Phila., 1892, p. 214, pl. 13, figs. G. H.

In AMERICA, the genus *Helix* is restricted to the West Coast[11] until Mexico is reached, where the species spread over the middle portion also. In South America the species are sparsely distributed. *Lysinoe* is the most prominent subgenus, including the larger Mexican and Californian species. *Epiphragmophora* occurs in South America; and the West Indian *Eurycampta* may perhaps belong here. Among the fossil forms may be mentioned the section *Glyptterpes* Pils., proposed for *Helix veterna* M. & H.

The writer has elsewhere[12] expressed the opinion that the American forms of true *Helix* reached this continent from Asia by way of a land bridge in the region of Bering Sea.

Subgenus GONOSTOMA Held.

Differs from *Helix* in the less complex genitalia and the white-lipped shell.

Genus LEUCOCHROA Beck.

This genus is allied to the restricted genus *Helix* in genitalia and dentition; it differs in having the jaw entirely smooth, with a low median projection. The characters separating it from *Helix* are not great, and have generally been much overestimated. It has often been said to be near *Zonites*, but this supposition is utterly without foundation. The species are mainly circum-Mediterranean, the best known being the common *L. candidissima*.

Genus ALLOGNATHUS Pilsbry.

Man. of Conch, (2), iv, p. 121, 149, 1888. Kobelt, Nachr. bl. D. M. Ges. 1891, p. 140.

Genitalia: ♀ system provided with two digitate glands each two-fingered; dart-sack having a four-bladed dart; duct of the receptaculum seminis bearing a long diverticulum. ♂ system having a long flagellum.

Jaw entirely smooth, slightly projecting in the middle.

Radula very large; teeth all of the same form, which is that of a semicircularly curved strap.[13]

The genital system is that of *Helix* s. str., resembling *Campylæa* as much as anything; but the smooth jaw and especially the extremely peculiar dentition, are sufficient to give generic rank.

[11]See Proc. Acad. Nat. Sci. Phila., 1888, p. 193.

[12]Check-list of Amer. Land Shells, p. 195.

[13]See Schuberth, Arch. f. Naturg. 1892.

The only species known is *A. grateloupi* Grælls (*grœllsiana* Pfr.), of the Island of Majorca. Probably *H. quedenfeldti* Mts. belongs here, also, as Kobelt suggests.

Genus COCHLOSTYLA (Fer.) Semper.

Genitalia: ♀ system having a globular mucous gland united with the dart-sack; ♂ system usually without a flagellum. Jaw strongly ribbed, rarely smooth. Brilliantly colored shells of arboreal habits, confined with a few exceptions, to the Philippine Islands.[14]

Genus POLYMITA (Beck) Binney.

Genitalia as in *Hemitrochus*. Jaw low, wide, arched, delicately striated, without ribs or median projection.

Teeth with a long quadrangular basal plate with gouge-shaped expanded cusp.

Shell globose, brilliantly colored, with simple lip.

This genus holds much the same relation to *Hemitrochus* that *Allognathus* holds to *Helix*. The extremely peculiar dentition, first made known by Binney, is very different from that of ordinary Helicoids, but is approached by a number of other fruit-eating arboreal snails. The species are all Cuban.

Genus HEMITROCHUS (Swainson) Pilsbry.

Man. of Conch. (2), V. p. 5. Proc. A. N. S. Phila. 1892, p. 129, pl. 6, figs. F, G.

Genitalia: ♀ system having a dart-sack and accessory mucous glands; duct of the spermatheca long, simple. ♂ system having a slender penis at the apex of which the vas-deferens and a long flagellum are inserted; retractor penis lacking.

Jaw highly arched, smooth except for some faint vertical striæ in the middle.

Dentition of the normal Helix type.

This group includes the sections *Hemitrochus*, s. str., *Plagioptycha*, *Dialeuca*, *Coryda*, and perhaps *Jeanneretia*. Possibly the continental section *Oxychona* belongs here. The species are all West Indian, inhabiting from Jamaica and Haiti northward to the

[14]Under *Cochlostyla* are included the sections enumerated by Semper (Land Moll. Phil. Arch.), several additional sections proposed by myself (Manual of Conch. (2), vii), and the curious *Helix cepoides* of Lea, formerly classed in *Stylodonta*, but referred to *Cochlostyla* by Dr. v. Moellendorff, under the sectional name *Ptychostylus*. This name being preoccupied by Sandberger for a tertiary genus of *Melaniidæ*, a substitute must be chosen; we propose, therefore, to designate the group *Hypoptychus*; *H. cepoides* Lea being the type, and thus far the only known species.

Bahamas and Florida Keys. The fossil species described by Dr. W. H. Dall from Florida belong mainly to *Plagioptycha*.

Genus **GLYPTOSTOMA** Binney & Bland.

Genitalia: ♀ system having an appendicula or a dart-sack entering the vagina. Vas-deferens entering the penis at its middle.

Jaw very low, broadly arched, having about sixteen strong separated ribs. Dentition normal.

Shell depressed, broadly umbilicated, having a simple, thin, acute lip.

The single species known is *G. newberryanum* W. G. Binn., of San Diego, California. The shell is entirely Patuloid in form, but not in texture. Its systematic position is doubtful.

Genus **ACANTHINULA** Beck.

Said to possess a dart-sack and mucous glands, and probably to be grouped here.

Genus **VALLONIA** Risso.

This genus of minute shells probably belongs here. A dart-sack is present.

Group III, TELEOPHALLA.

Female genital system lacking all accessory organs; male organs complicated by the presence of a long flagellum and a well-developed appendix.

Jaw thin, delicately plaited or distantly striated (or smooth ?).

Besides the two genera given below, this group perhaps includes *Pararhytida* Ancey, an oxygnathous group.

Genus **SAGDA** Beck.

Genitalia: ♀ system without accessory organs; duct of the spermatheca long. Ova rather large, few in number, with calcareous shell. ♂ system having a long penis at the apex of which are inserted the retractor muscle, vas-deferens, and a long, folded flagellum; and at the middle of the penis is inserted a very long but simple flagellum-like appendix.[15]

The jaw is thin, delicate, arched, composed of narrow vertical plates soldered together. Dentition typically Helicoid. Foot long and narrow.

Distribution, Jamaica.

[15]See Pilsbry, Proc. A. N. S. P. 1892, p. 213, pl. 13.

Shell rather glassy, with many narrow whorls and thin, acute, outer lip.

Genus CYSTICOPSIS Mörch.

Man. of Conch. (2) v. p. 5. 7. Proc. A. N. S. P. 1892, p. 214, pl. 13.

Genitalia: ♀ system without dart-sack or mucous glands; duct of the spermatheca very long, having a diverticulum; uterus much distended, retaining the numerous young which are born living. ♂ system having a long flagellum upon the penis, and a glandular appendix which terminates in two long flagellum-like processes.

Jaw vertically striated. Teeth normal.

Shell thin, globose, the lip thin, acute, not expanded or reflexed.

Foot short, wide.

Distribution, Cuba and Jamaica.

Group IV, EPIPHALLOPHORA.

Genitalia: ♀ system without accessory organs; ♂ having the penis continued into an epiphallus which generally bears a flagellum.

Jaw smooth (oxygnath), or ribbed (odontognath).

The species of this group require much more investigation before we shall be in a position to correctly classify them. Most of the large, solid Helices of the tropics and the southern hemisphere belong here.

- Tropical American forms.
  - Caracolus.
- Forms of S. E. Asia, etc.
  - Camæna.
  - Camænella.
- Australo-Moluccan forms.
  - A feathery glandular appendix on penis.
    - Obba.
  - No appendix; epiphallus sometimes degenerate.
    - Chloritis.
    - Hadra.
    - Planispira.
    - Papuina.

Genus CARACOLUS (Montfort) Pilsbry.

Genitalia: ♀ system lacking accessory appendages; ♂ system having the retractor muscle and a long epiphallus inserted at the apex of the penis, the epiphallus continued as a short flagellum beyond the insertion of the vas-deferens. Duct of spermatheca long or short.

Jaw either smooth or stoutly ribbed; teeth normal.

Distribution, West Indies and Northern South America.

The following sections belong here: *Caracolus* s. s., *Lucerna*, *Dentellaria*, *Isomeria*, *Labyrinthus*, * * *Eurycratera*, *Parthena*, *Polydontes*, *Thelidomus*, *Liochila*, and probably *Cepolis*.

Genus CAMAENA (Alb.) Pils. & v. Moell.

Pilsbry, Manual of Conch. (2) VI, p. 197. Moellendorff, Nachrichtsbl. d. D. M. Ges. 1891, p. 195. Pilsbry, *l. c.* 1892, p. 71.

Genitalia: ♀ system having no accessory appendages; the vagina is bound to the wall of the body-cavity by a thin muscle band; duct of the spermatheca very long. ♂ system provided with a very muscular penis containing a penis-papilla, and continued above in an epiphallus and flagellum; retractor attached to the epiphallus.

Jaw ribbed.

Distribution, South-east Asia, Philippines, etc.

The specimen dissected by me was sent without the shell by Dr. v. Moellendorff.

As sections or subgenera of *Camæna* the following may be placed: *Camæna* s. s., *Pseudobba*, *Phœnicobius* and *Camænella*.

Subgenus CAMÆNELLA Pilsbry.

Genitalia as in *Camæna*, but penis-papilla very large. Jaw ribbed. Marginal teeth of the radula wide, low, and multicuspid. Shell (see Manual of Conch. (2) VI, p. 239).

Type *Helix platyodon* Pfr.

See figure accompanying this paper. The specimens dissected were sent me by Dr. v. Moellendorff.

Genus OBBA Beck.

=*Obbina* Semper.

Genitalia: ♀ system without accessory organs; ♂ system having a flagellum and a feather-like glandular appendix.

Jaw smooth; teeth not peculiar.

Distribution, Philippines and some adjacent islands.

Genus CHLORITIS Beck.

Genitalia: ♀ system without accessory appendages; ♂ system having a long epiphallus inserted with the retractor muscle at the apex of the penis, and continued beyond the insertion of the vas-deferens as a flagellum.

Jaw stout, strongly ribbed; teeth not peculiar, the marginals tricuspid.

Hadra is very closely allied to *Chloritis* in anatomy and shell, and should probably be considered a subgenus. The groups *Papuina* and *Planispira* are also near to *Chloritis* in anatomical features, and if all were united the group would be about equivalent in value to the other groups herein called genera. A closer study of specimens may, however, show differences not known to me.

Contrary to the general rule, the presence or absence of a flagellum seems to be a character of very trifling import among the species of the group *Chloritis* + *Hadra* + *Papuina* + *Planispira*; the epiphallus also is lacking in some of the species, notably in *Cristigibba*. This is a case of degeneration, in all probability, comparable to the Fruticicoloid forms in which the vaginal appendages are lost, or to the section *Canistrum* of *Cochlostyla*.

The shells of some species of *Chloritis* are very like some of *Dorcasia*, but the anatomical characters very widely separate these two groups.

Subgenus HADRA Alb.

Genitalia scarcely differing from *Chloritis* except that the flagellum is frequently lacking. Jaw and teeth similar to those of *Chloritis*.

These, like the species of *Chloritis*, are ground snails.

Distribution, Australia.

This division I formerly considered a genus, but I agree with my friend Hedley who holds that it is scarcely separable from *Chloritis*.

Genus PAPUINA Martens.

Genitalia: ♀ system without accessory appendages; ♂ system usually having a flagellum upon the penis, but it is sometimes lacking. Jaw delicate, coarsely ribbed.

Differs from *Hadra* in the shell, the exclusively arboreal station, and the more delicate jaw.

Genus PLANISPIRA Beck.

Genitalia as in *Papuina*, the flagellum being present in typical *Planispira* (*zonaria*), absent in sect. *Cristigibba*.

Jaw smooth, ribless.

Differs from *Obba* in lacking the glandular appendix; from *Papuina*, *Hadra* and *Chloritis* in the smooth jaw; but it will prob-

ably be found to intergrade with *Chloritis* in characters when more species are known anatomically.

Group V, HAPLOGONA.

Genitalia entirely lacking accessory organs; penis without an epiphallus; jaw smooth (oxygnath), vertically striated (aulacognath), or flatly plaited (stegognath). Outer lateral teeth generally multicuspid. This group may be classified thus:

- Aulacognath or stegognath; shell with simple, sharp lip.
  - A mucous pore on the tail — *Endodonta.*
  - No mucous pore; aulacognathous.
    - *Patula.*
    - *Anoglypta.*
    - *Trochomorpha.*
- Odontognath; shell having reflexed or thickened lip.
  - *Polygyra.*
  - *Polygyrella.*
  - *? Praticoiella.*

Genus POLYGYRA (Say) Pilsbry.

Proc. Acad N. S. Phila. 1889, p. 193.

Anchistoma, in part, of H. & A. Adams, Tryon, Fischer, *et al.*

The genital system lacks all accessory organs, there being no dart-sack, no mucous glands, no flagellum on penis; the duct of the spermatheca is short and simple, without an accessory blind sack.

The jaw is strongly ribbed, and there is no median projection on its cutting edge.

Oviparous, the eggs small, numerous.

Shell helicoid, varying from globose to lens-shaped or planorboid; horn-colored or brown, sometimes banded, the most constant band supra-peripheral; striated; lip flatly reflected; aperture teeth often wanting, but typically three—1 parietal, 2 upon the lip; axis perforated, umbilicus open or closed.

Distribution, North America. We have every reason to believe that this group has been in the past, as it now is, exclusively North American.[16]

Subdivisions.—The group is quite homogeneous, easy transitions being traceable between the various sections, through species which are quite intermediate. Sections: *Polygyra* s. str., *Dædalochila*, *Triodopsis*, *Mesodon*, *Stenotrema.*

In the "Nomencl. and Check-list of Amer. Land Shells" (1888) this genus was correctly defined, but several groups not agreeing with my diagnosis were included. These groups were subsequently

[16]See Pilsbry, Journal de Conchyliologie, Paris, 1891, p. 22.

eliminated by me (Proc. Acad. Nat. Sci. Phila., 1890, p. 299; The Nautilus, August, 1891, and Jour. de Conch. 1891, p. 22.) and the genus restricted to its present limits.

Genus ENDODONTA (Albers 1850) Pilsbry.

Shell patuloid, with or without folds or denticles within the aperture; generally horn-colored with radiating or zigzag reddish flames.

Animal having a more or less developed caudal mucous gland,[17] and supra-pedal furrows.

Genitalia unknown, but probably like *Patula*.

Jaw thin, delicately ribbed (stegognath) or striated. Central and lateral teeth as in *Patula*; marginal teeth low, wide, having one or several short cusps; rarely pseudo-zonitoid.

Distribution, Oceanica, New Zealand, Australia.

The elucidation of this group is involved in considerable confusion. Albers and other early authors give shell characters only, in defining their groups. Hutton first called attention to the anatomy of species related to *Endodonta*, and to the fact that certain of the New Zealand forms possessed a caudal slime-gland; and he founded a family "*Charopidæ*" on this peculiarity, characterizing numerous generic groups therein. Suter (Trans. N. Z. Institute, 1880–1892) made certain modifications, and considerably enlarged the limits of the family, the name of which he changed to "*Phenacohelicidæ*." The writer made some observations upon the systematic position of these groups in The Nautilus, Sept., 1892, and grouped all of the mucous-pore bearing genera under the generic name *Gerontia* Hutt. A month later proof-sheets of Mr. Charles Hedley's article upon *Charopidæ* were received at Philadelphia. This valuable paper contained a synopsis of all previous publications known to the author upon the subject, and the fact that *Endodonta, Pitys, Charopa*, etc., possess a mucous tail gland, like *Gerontia*, etc., was for the first time brought forward.

A brief review of Mr. Hedley's article appeared in The Nautilus for October, 1892. Mr. Hedley does not give the same limits to his *Charopidæ* that the writer gave to *Gerontia;* nor would it be expected, as our papers, his in Australia and my own in America,

[17]The credit of the discovery that the Patuloid forms (such as *Charopa*) herein included possessed a caudal gland, rests with my friend Charles Hedley, of Sydney, N. S. W., whose observations both printed and in letters have influenced largely the limits here given to this group. My former views are shown in the "Observations on New Zealand Helices" in The Nautilus for Sept., 1892.

were written each in complete ignorance that the other was engaged upon the group in question.

The present genus, therefore, is the product of our independent labors, and is equivalent to *Charopidæ* Hedley *plus Gerontia* Pilsbry. It therefore includes *Phenacohelicidæ* Suter and *Charopidæ* Hutton.

The choice of the name *Endodonta* for the genus is inevitable, as it is the oldest proposed. The following groups seem to belong here:

Endodonta s. str. (+ *Pitys* Pse. *non* Beck).
Libera Garrett.
Diaglyptus Pils. (? ? = *Pitys* Beck, never defined).
Simplicaria Mouss. (= toothless *Endodonta*).
Maoriana Suter (*Huttonella* Suter, preoc.).
Æschrodomus Pils. (= *Thera* Hutt., preoc.).
Charopa Alb.
Gerontia Hutt.
Therasia Hutt.
Calymna Hutt, (*plus Amphidoxa* Hutt. *non* Alb.).
Pyrrha Hutt.
Phenacohelix Suter (= *Fruticicola* Hutt. *non* Held).
Allodiscus Pils. (= *Psyra* Hutt., preoc.).
Suteria Pils. (= *Patulopsis* Suter, *non* Strebel).
Thalassohelix Pils. (= *Thalassia* of N. Z. authors *non* Alb.; not *Thalassia* Chevrolat).
Phacussa Hutt.

Genus **PATULA** Held.

Genital system lacking all accessory appendages. Jaw vertically striated. Marginal teeth multicuspid.

This genus includes the typical forms of Europe and America (*Discus, Anguispira, Pyramidula, Gonyodiscus*), and also the subgenus *Helicodiscus* Morse. Perhaps *Zoogenites* Morse. Various forms of this genus are found in most parts of the world, except Oceanica, Australia, etc.

Genus **TROCHOMORPHA**.

Semper, Reisen im Archip. Phil., Landmoll.

Distinguished from *Patula*, etc., mainly by the keeled and otherwise very different shell and the differently shaped marginal teeth of the radula.

Genus ANOGLYPTA Martens.

Hedley, Proc. Linn. Soc. N. S. Wales (2), VI, p. 22, 1891.

Genitalia simple as in *Trochomorpha;* jaw and teeth also resembling that genus, from which this is sundered mainly on account of the peculiar shell.

Distribution, Tasmania.

Group VI, POLYPLACOGNATHA.

Genitalia lacking all accessory organs; jaw composed of numerous separate quadrangular plates; lateral teeth bicuspid.

Genus PUNCTUM Morse.

Genital system like *Patula.* Jaw composed of about 16–19 separate quadrate plates. Dentition: central teeth unidentate, laterals bidentate.

Shell discoidal, with round, crescentic aperture, and thin, acute lip.

Distribution, Holarctic realm.

Differs from *Microphysa,* etc., in having the plates of the jaw actually unsoldered, but connected by a delicate membrane.

Genus LAOMA (Gray) Pils.

Genital system unknown. Jaw composed of 20–24 quadrangular papillose plates. Central tooth unicuspid, side teeth all bicuspid.

Shell more or less trochiform, generally keeled and variegated; aperture rhomboidal, lip thin, simple.

Section *Laoma s. s.,* aperture with lamellæ within.

Section *Phrixgnathus* Hutton, aperture without lamellæ.

Distribution, New Zealand.

My knowledge of the anatomy of this genus is derived from the writings of Hutton and Suter. The jaw should be compared with that of *Phacussa, Therasia,* etc. The lateral and marginal teeth are peculiar and very characteristic.

Genera of Doubtful Position.

Genus STROBILOPS Pilsbry.

Strobila Morse 1864, not Sars 1833.
Strobilus Sandberger *et al.,* not Anton 1839.

Genitalia unknown. Jaw ribbed.

This genus is represented by many species in the middle and later tertiary of Europe, and by several living species in America,

extending south to Venezuela. It is therefore, like *Vallonia*, *Zonitoides*, *Pupilla*, etc., a genus of the Holarctic realm.

The New Zealand forms referred to *Strobila* have been separated under the name *Maoriana* by Mr. Suter. They are a modification of *Endodonta*.

Living Species.	European Tertiary Species.
S. labyrinthica Say.	*S. uniplicata* Al. Braun.
Var. *strebeli* C. & F.	*S. elasmodonta* Reuss.
Var. *virgo* Pils.	*S. diptyx* Boettg.
Var. *affinis* Pils.	*S. costata* Sandb.
Var. *morsei* Dall.	*S. labyrinthicula* Mich.
S. salvini Tristr.	*S. sublabyrinthica.*
S. hubbardi A. D. Br.	(Syn. *H. lautricensis* Noul.)
(Syn. *H. vendryesiana* Gloyne.)	*S. monile* Desh.
	S. pseudolabyrinthica Sandb.
	S. duvalii Mich.

Genus AMPELITA Beck.

Anatomy unknown.[18]

Genus PEDINOGYRA Alb.

Hedley, Proc. Roy. Soc. Queensl. 1889, and Proc. Linn. Soc. N. S. Wales, 1892.

This genus has characters of groups I and IV, with others allying it to *Panda*.

Genus POLYGYRATIA Gray.

Anatomy unknown.

Genus MACROCYCLIS Beck.

This group is still unknown anatomically. A single species, *M. laxata*, is known. It may belong to *Helix* s. str.

Genus SOLAROPSIS Beck.

Manual of Conchology (2), v, p. 177.

This genus rests, at present, wholly upon conchological characters.

[18] *A. xystera* has been dissected by the author since this paper was written. It presents peculiar characters which leave the position of the genus problematic.